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ABSTRACT

Aside from direct supervision at a recreational facility, safety signs, if designed properly, are the most effective approach to facility safety. This study was conducted to investigate the effectiveness of various sign designs: (1) multiple concepts with text; (2) single concept with text; and (3) single concept with graphics. A discussion of recall and short term memory is included. College students (N=53) were divided into 3 groups. Group A was exposed to a single concept sign with text; group B was shown a single concept pictorial display; and group C was shown a traditional multiple safety concepts sign. The students were then asked several questions using a whole report method in order to test for recall. The results suggest that single-concept graphic signs provide the strongest visual signal to the observer. The results also imply that educators and recreational facility managers need to re-evaluate their signs, regardless of the activity or recreational site, to maximize and convey the correct safety messages to participants. (LL)

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Designing Effective Safety Signs

Based on a Study of Recall for Safety Signs

Dennis W. Berry

The importance of warning users of the hazards present at any given swimming (or recreational) facility is essential from both an educational and legal standpoint. Generally, there are two forms of warnings which are utilized at recreational sites. The first, active warnings, include all forms of verbal communication or physical restraint in drawing attention to hazards or dangerous situations. This is best achieved through direct supervision of activities and facilities. The second form to be considered is passive warnings which include indirect, yet constant visual communication usually through the use of signs.[1] It is this form of warning which this paper will address.

Hazard identification should be specific to the facility, providing information in both active and passive forms that can be used by patrons for appropriate hazard avoidance behaviors during recreational activities. When negligence is investigated as it is applied to a recreational injury, the failure to warn with regard to the specific facility hazards (nonfeasance) have been proven to be the responsibility of management.

The function of a safety sign and the question of how to design its message, impacts the safety of participants in this high risk arena of recreation. The importance of identifying hazards are magnified when first time users are involved. A recent study on aquatic accidents suggest that many accidents occur to bathers who are using a facility for the first time.[2] This concept is important for facility administrators to understand. A safety sign is considered to be any posted sign which conveys a warning, caution or danger to an observer. Passive education is the primary function of safety signs posted within facilities. This educational process is met by providing visual information which can be analyzed by the observer to draw a clear picture of the dangers inherent to the specific site or activity. The purpose of posting a safety sign for participants should be three-fold:

1) to **identify** an immediate or hidden hazard to the observer
2) to **convey** an urgent message of danger or caution to the observer
3) to attempt to **modify** the behavior of the observer in such a way as to prevent injury.[3]

When signs conveying this three fold message are available, the observer is provided adequate information by which an educated decision can be made. This author suggested in 1989 that the message design should include several specific conditions to allow for a complete understanding of the immediate environment or situation. Three conditions which safety signs should incorporate to project an effective message include:

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[1] Berry, W. Dennis, *Safety signs and warnings in aquatics* , Presented at the AAHPERD National Convention in Boston, Mass., April 1989.

[2] Bishop, Brian, P., *An analysis of the underlying causes of selected swimming pool accidents,* Masters thesis, Indiana University of Pennsylvania, 1990.

[3] Berry, W. Dennis, Safety signage and warnings in recreational facilities, *The Maryland Journal of Health, Physical Education Recreation and Dance,* Spring 1989.

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1) **Visual signals** which grab and sustain the observer's attention. Words which are often used include *danger, warning,* or *caution.* Graphic symbols universally identified with danger or caution may also be used to meet this need.
2) **Specific identification** of the hazard such as shallow water, exposed metal fixture or hidden hole must be included to completely inform the observer of what conditions are actually dangerous.
3) **Expected behavior** of the observer during activities includes rules such as no diving, no swimming, or area closed for use.[4]

In addition, whenever possible the **consequences** to the observer who does not follow posted directions should be posted (such as failure to obey these rules will result in serious injury, possible death).

There are many other factors which need to be considered in the final development of safety signs, such as size, placement, color and effective dissemination of the message's content. Some very descriptive pictorial signs have been developed by the Royal Life Saving Society of Canada and have been in use since the early 1980's. By modifying internationally recognized sign shapes (figure 1) to convey aquatic safety messages, the Royal Life Saving Society of Canada established an innovative approach to presenting safety concepts to recreational swimmers. Recent attempts to develop standardized warning signs have been focused on two major risks: diving into shallow water, and drowning. Research aimed at sign recognition has indicated that single concept signs are understood if designed properly.[5]

Specialists in industrial safety have suggested that excessive text used on signs may obscure the objective of the warning.[6] It is this paradox that prompts this study into sign design. If we are to include three or four major concepts into every safety sign, are we creating a sign which will not be observed thoroughly for its full message? Or should signs carry only a single concept to convey a warning ?

This study investigated the possibilities of single concept signs being recognized and recalled with more accuracy than multiple concept signs. As a further means of narrowing the study, single concept signs were presented in text and iconic form. The study will investigate the retention levels of college students who are exposed to one of three safety signs specific to a swimming pool. The specific question being investigated is whether there is any difference in recall ability for safety concepts presented in the form of single concept text , single concept icon, or multiple concept text forms.

To understand the importance of recall on safety signs, a review of the memory process is essential. The question of how much information can be received and how long it can be retained in the sensory registry has been addressed in many studies. Studies in the area of cognitive psychology point out that visual signals must be current or constant for information to be processed into working memory. Short exposure to visual signals may allow for automatic processing to working memory if the information is used or re-

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4 Ibid.

5 Dorris and Associates, Inc., Precautionary information for swimming pools and spas, Alexandria, Va., National Swimming Pool Foundation. October 1986.

6 Peters, George, "Warnings", *Hazard Prevention,* January/February 1986.

called for use within a short time.[7] It has been established that retention in short term memory is limited to seven, plus or minus two items, although many argue that the short term store has a probable size limit of four or five items. This size limit for information gathered in short term memory might be associated with our attention span. In either event the number of items presented on signs (symbols, words or phrases) must not impair the retention of the observer by its number alone. For this reason we will use single concept and multiple concept safety messages for recall by the study group.

Methodology

Fifty-three (53) college students were tested for this study. The students were randomly selected and divided into three different study groups with each shown a different safety sign. As an experiment with the use of digitized images and computer graphic applications for research, the Macintosh computer and Hypercard™ were used. All students tested in this study were familiar with the Macintosh computer and its capacity to produce fairly accurate digitized images, which justified its use for this experiment. Each student was shown a three (3) second exposure of a digitized scene showing a swimming pool with a safety concept posted on an adjacent wall. Group A was shown a single concept text sign (figure 2) while group B was shown a single concept icon display (figure 3) of a safety concept. Group C was shown a traditional text sign (figure 4) showing multiple safety concepts. After the three (3) second exposure to the pool scene, the students were shown a five (5) second exposure to a neutral (white) screen. At this point the students were asked three questions related to the exposure using a whole report method.

Questions asked to all study participants were:

1. Can you identify or describe the scene shown on the screen?
   Correct response: A swimming pool
   Purpose: *To determine whether the digitized scene was identified as a swimming pool.*

2. Did you see any posted signs ?
   Correct response: Yes
   Purpose: *To determine if signs were noticed in the digitized scene.*

3. Can you describe what the sign meant ?
   Correct response(s): Group A Danger
   Group B Danger
   Group C Pool Rules Sign
   Purpose: *To determine whether the sign's general content could be identified.*

The analysis was a determination of accuracy of recall between those shown single concept text signs, single concept icon signs and multiple concept text signs. The response expected to the final question was made as general as possible due to the short exposure (3 seconds) to the scene.

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[7] Spillich, George, Chair, Psychology Department, Washington College, Chestertown, Md. Personal Communication, March 1990.

Results

Based on the statistical analysis (Table 1), there are several conclusions that can be drawn. Each conclusion gives cause for additional, more detailed investigation to further explore the area of hazard identification.

1) Single Concept Signs

Of the two groups shown single concept signs, each had a higher percentage of students identifying both the presence of a sign during the test exposure and its correct safety concept over those shown the multiple concept text signs. An analysis between single concept graphic signs and the multiple concept text signs carried statistical significance (>.05) when comparing the conceptual understanding of the sign's message. This demonstrates the importance of sign design for effective communication of safety warnings. This also indicates that traditional signs which are posted to inform patrons of a variety of pool rules and policies may not be visually distinctive enough to capture the attention of the observer, and further, multiple concept signs may be too informative, especially at recreational environments, to convey an important safety message.

2) Iconic signs versus text signs

Of the study groups, the students shown the icon/graphic display had the highest percentage of sign identification, correct sign content identification, as well as sign effectiveness based on the total number of students exposed to the concept. This infers that iconic displays are not only readily recognized but are actually better understood than are text displays on signs. In use at recreational facilities, iconic displays may provide a stronger visual signal to the observer to convey a safety message.

3) Effectiveness of sign design

Again, iconic displays have the highest percentage of respondents who could correctly identify the sign's safety concept. This may be attributed to the unique graphic design, compounded by the single concept message. When applied to recreational facilities this indicates a strong need to evaluate sign design and traditional approaches in presenting safety warnings. With a 15% effectiveness rate for multiple concept text signs, it is very doubtful that safety warnings which are posted in this manner are actually observed .

Observations

The results of this study should be used by educators and facility administrators to prompt an evaluation of the design and effectiveness of the safety signs utilized at their local facilities. It also provides an argument for the use of single concept safety signs for effective warnings of specific hazards within facilities. It is hoped that further studies in this area might investigate specific types of iconic displays which may best convey accurate messages to patrons.

This study should provide an insight into the best possible method of presenting safety concepts and hazard warnings at recreational sites. Regardless of the activity or recreational site, effective safety signs which clearly convey the correct message are needed to provide a safe environment for participants. If multiple concept signs are not effective in capturing and sustaining the attention of observers, and if short term memory has a small storage limit, then signs must be designed with prioritized concepts to maximize the brief exposure patrons will have to the message.

Specific Recommendations

- graphics should be used to display safety messages whenever possible
- text signs must be briefly stated and plainly worded
- signs designed to warn should not carry other non-safety messages
- warning signs should be posted in the immediate proximity of the hazard

The content of posted signs should be designed to separate safety warnings from other policies related to daily operation. In a recreational aquatic facility, the traditional rule sign may not provide a suitable warning to bathers and may be challenged in legal action where the issue of warning effectiveness is raised. Administrators of recreational programs and facilities must continue to explore innovative ways to heighten hazard awareness. Aside from direct supervision, safety signs, if designed properly, are the most effective approach to facility safety.

About the Author:

Dennis Berry is the Director of Recreational Sports and the Casey Swim Center at Washington College in Chestertown, Md. He has a M.A. in Psychology and is the former chair of the AAHPERD Aquatic Council and is active in the aquatic committees of the NIRSA and NRPA.

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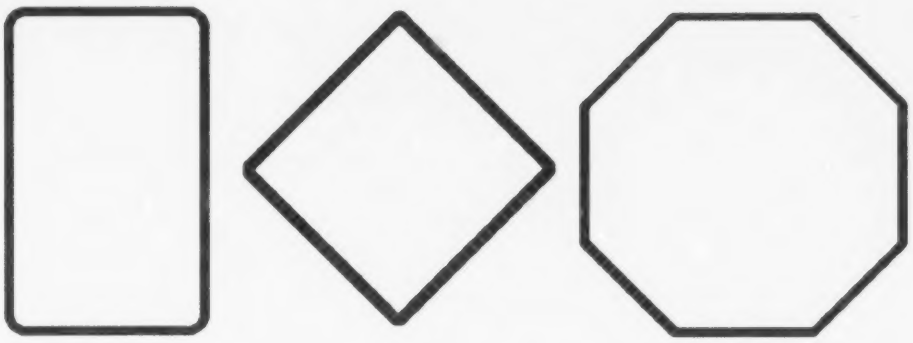
Figure 1

International Shapes



Information Caution Danger

Figure 2
Single Concept Text

Danger
No Diving

Figure 3
Single Concept Icon

Figure 4
Multiple Concept Text

Pool Rules
No Diving
No Horseplay
No Running
No food on the deck
ID required

Table 1

Data Analysis

Group	Site	Question #1 Identification	Question #2 Recognition	Question #3 Understanding
Single Concept Text	8 yes	4 no	6 yes 6 no	4
Single Concept Icon	16 yes	6 no	17 yes 5 no	13
Multi-Concept Text	12 yes	7 no	7 yes 12 no	3

Total Number of Respondents **53**
Percentage that correctly identified pool site 67.92%

Percentage that identified single concept text display as a sign 50.00%
Percentage that identified icon/graphic display as a sign **77.27%**
Percentage that identified multiple concept text display as a sign 36.84%

Sign Effectiveness
Based on the total number of those exposed who correctly understood the sign's message or concept

Single Concept Text 33.33%
Single Concept Icon/Graphic **59.09%**
Multiple Concept Text 15.78%

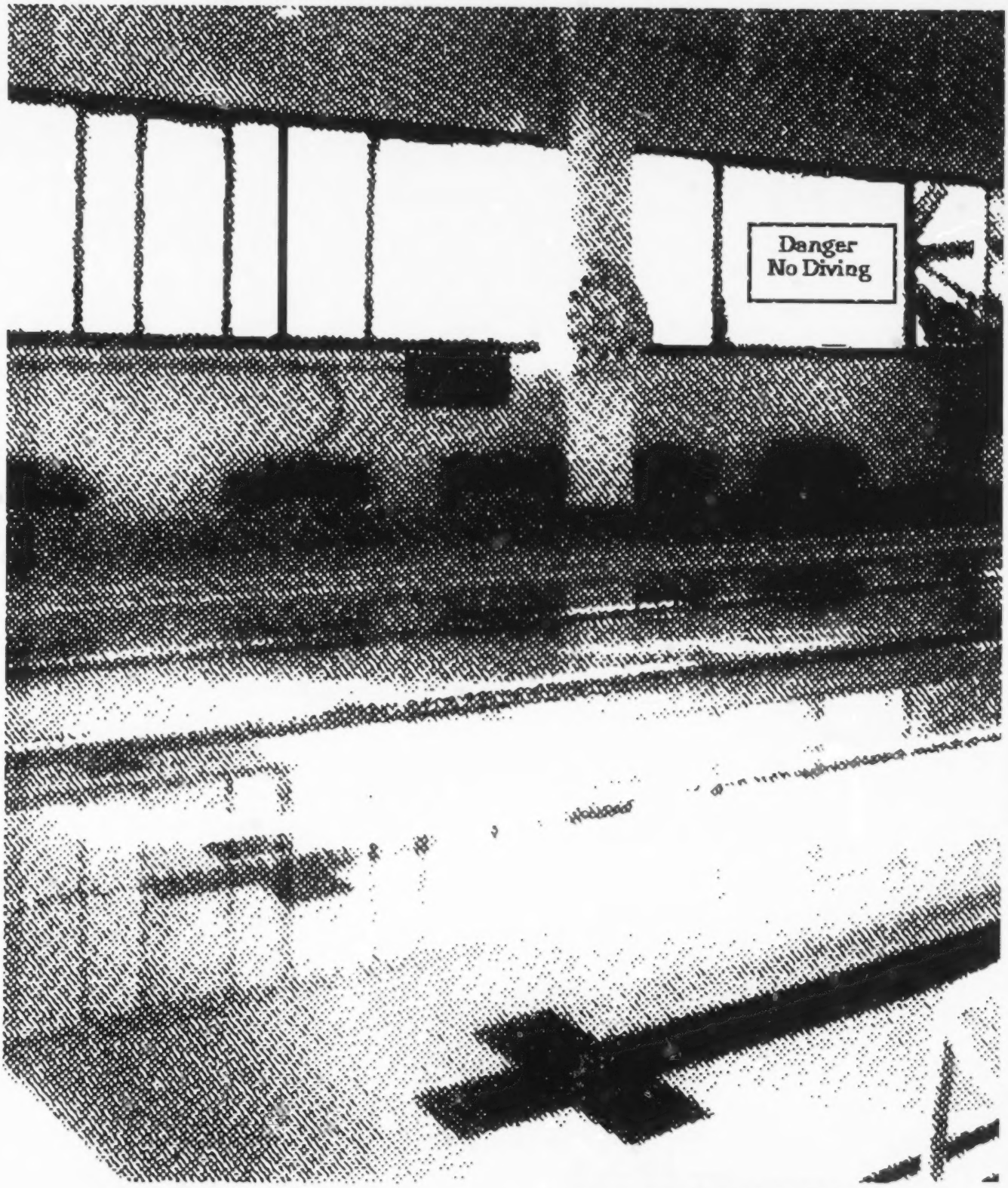
The *Test for Significance of a Portion* was used to compare the effectiveness of each sign to each other. In this test the following results were recorded:

Single Concept Text (N=12) compared to Single Concept Icon/Graphic (N=22) not significant
Single Concept Icon/Graphic (N=22) compared to Multiple Concept Text (N=19) >.05
Single Concept Text (N=12) compared to Multiple Concept Text (N=19) not significant

Study Limitations:

- Total number of subjects exposed to study was 53.
- Quality of digitized scene in study exposure to subjects.

Research Conducted: February 1990



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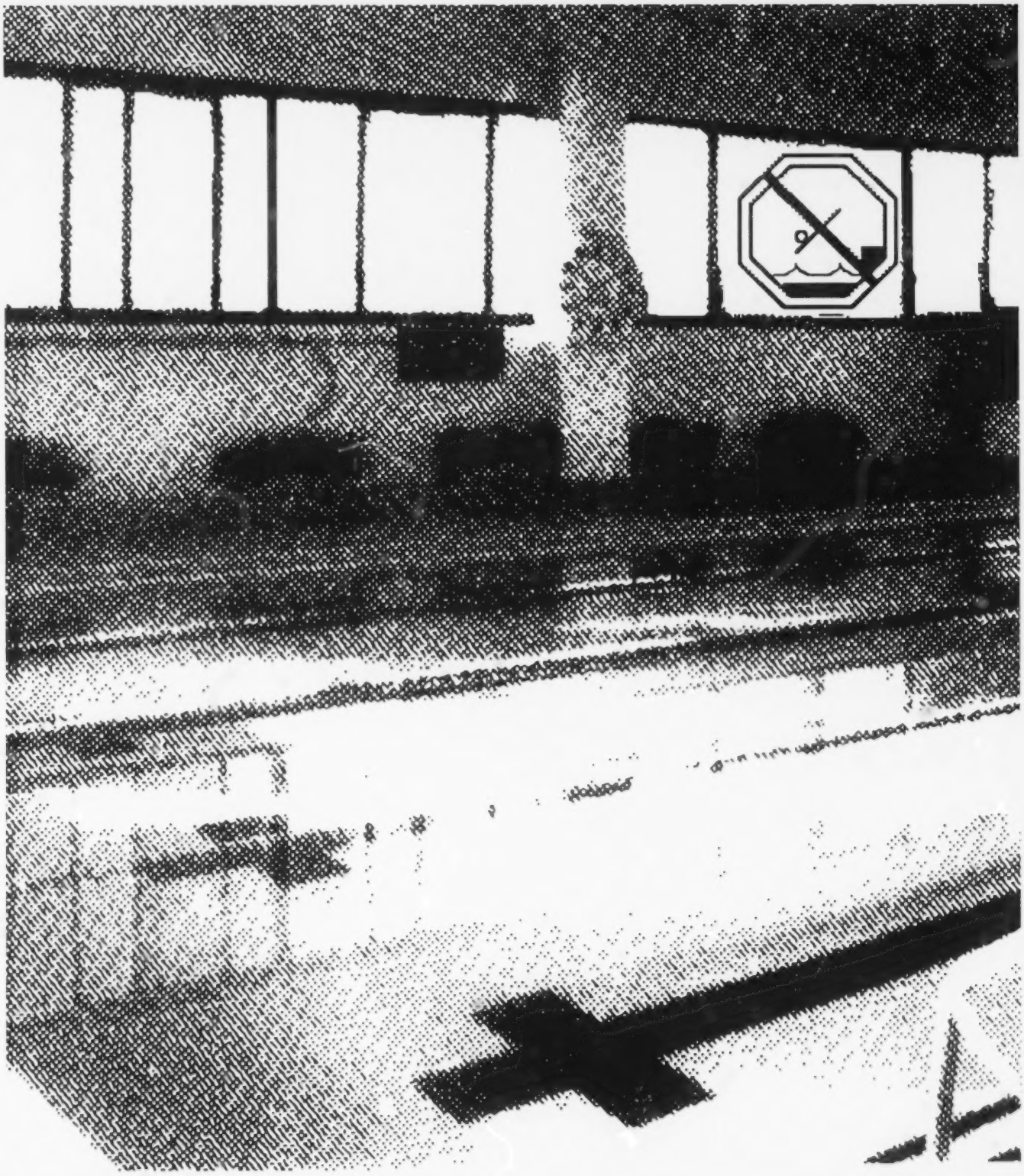
Study B Single Concept: Iconic



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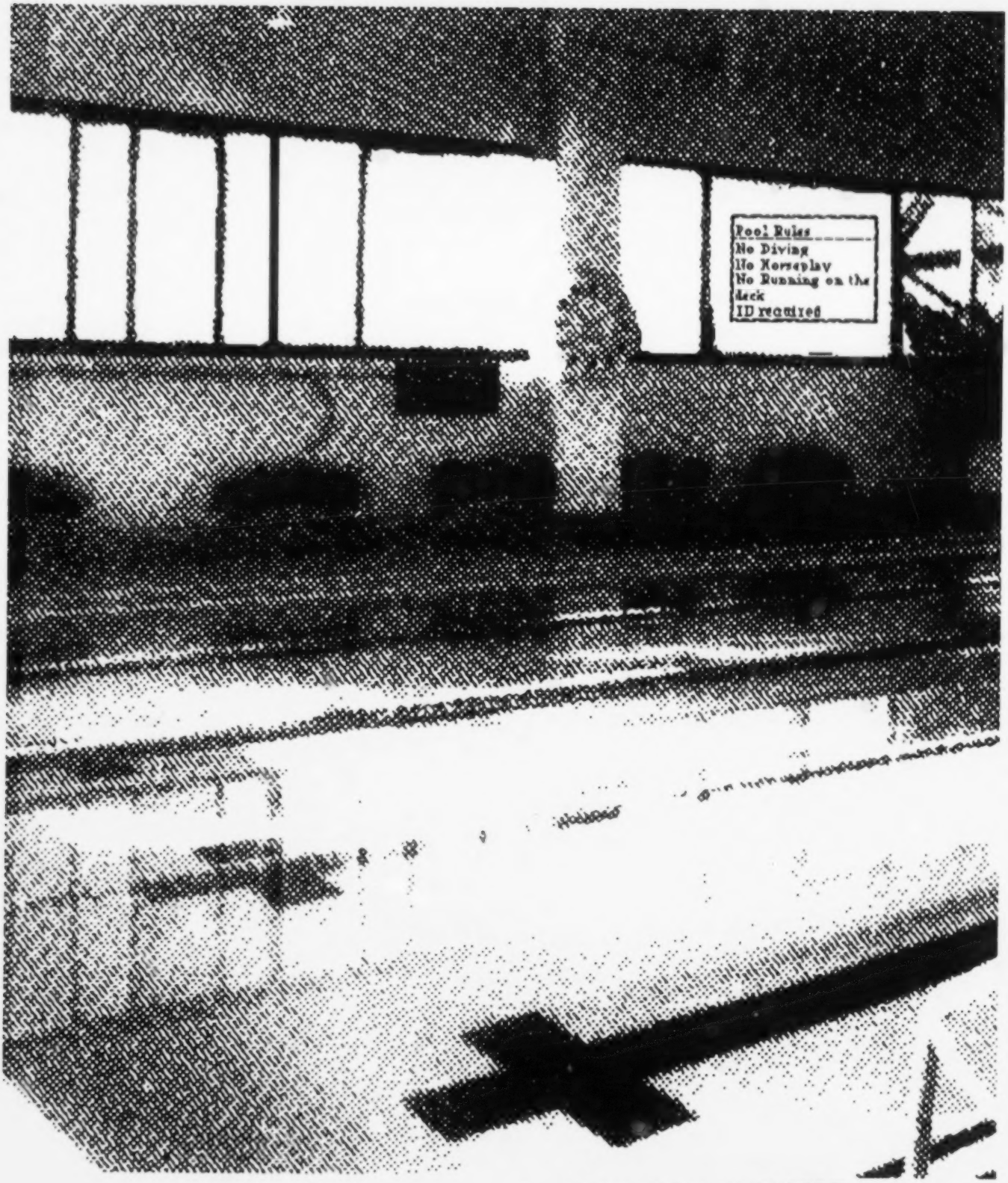
Study Group C Multiple Concept: Text



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